Three layer circulation

- ***The discovery of a three-layer circulation in Baltimore Harbor by Prichard and Carpenter in 1960 has received attention far beyond the realm of those concerned with the flushing characteristics of the Harbor system. Physical oceanographers and fluid dynamicists have been intrigued by the flow patterns…***

Boicourt and Olsen, 1982

Why use models?

All models are wrong.
Some models are useful.

--*G.E.P. Box*

All substances are poisons; there is none which is not a poison.

The right dose differentiates a poison and a remedy.

--*Paracelsus*
(1493-1541)

Chemical Contaminant Modeling: Endpoints

- Concentration in water
  - total and dissolved
- Concentration in sediment
  - Active biological zone
- Concentration in fish tissue
  - Game and accumulator species

Total Maximum Daily Load

We wish to manage loads to influence concentrations

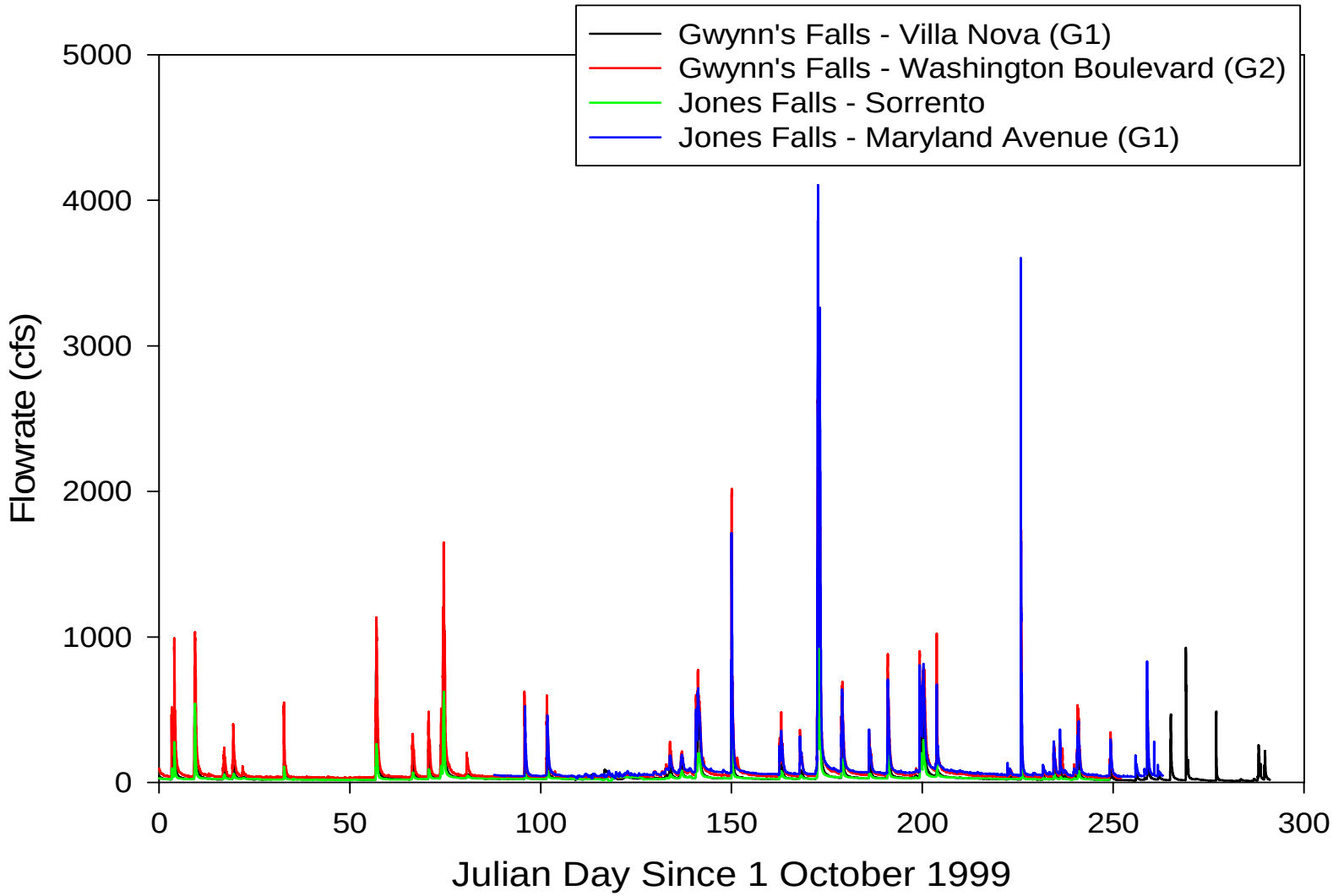
What is the relationship?

The KISS School of Modeling

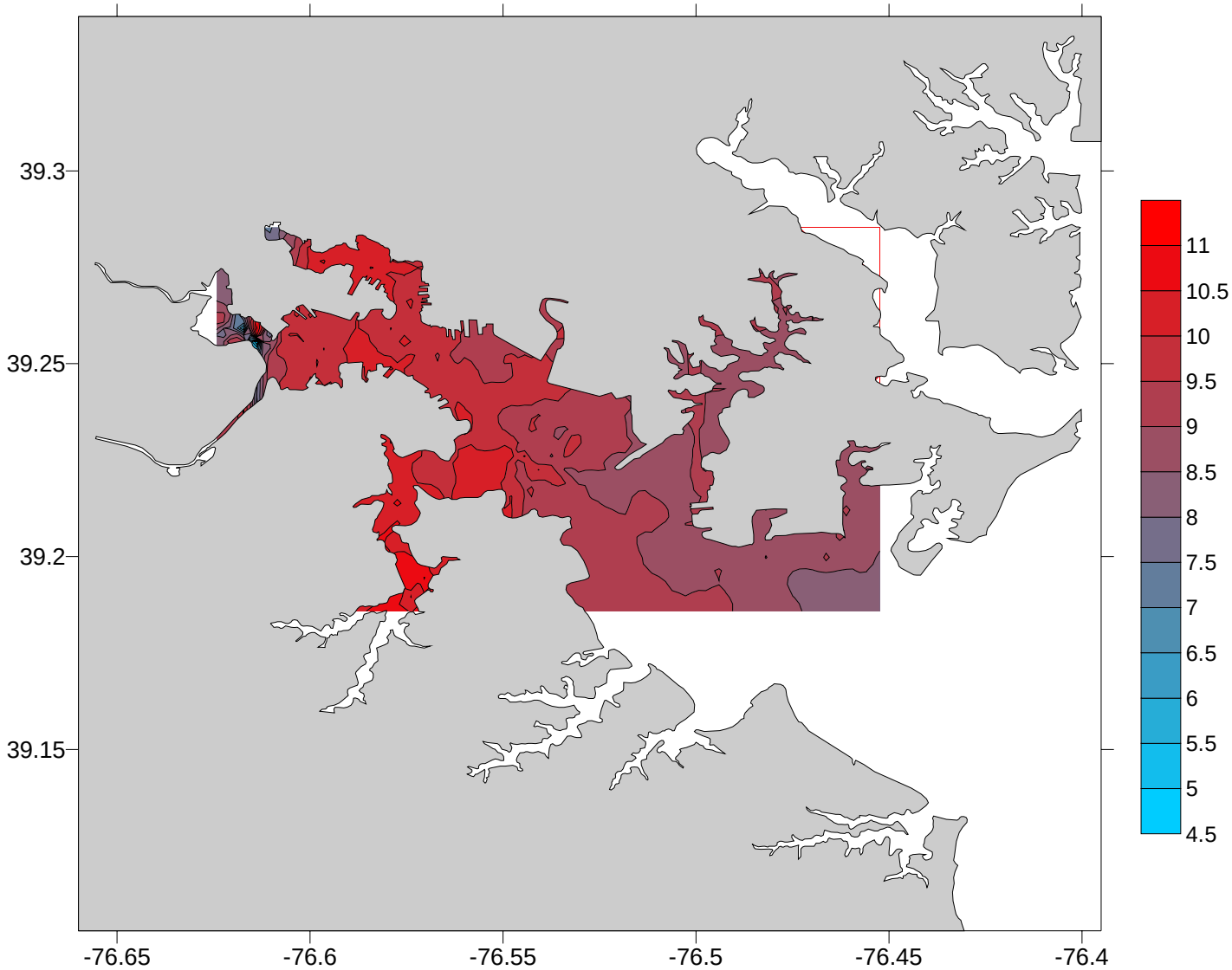
- Make Assumptions
  - Well-mixed system
  - Constant loads

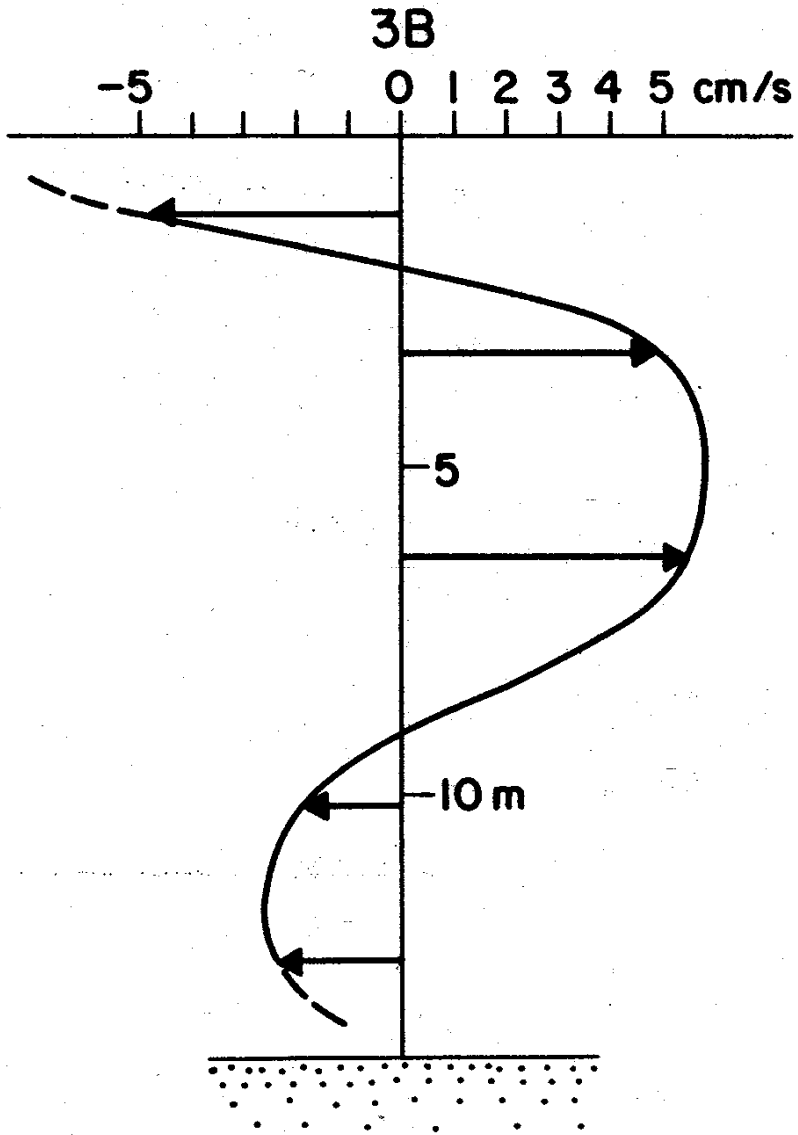
$$\text{Concentration} = \frac{\text{Loading}}{\text{Volume}} \times \frac{1}{\text{Reaction Rate}}$$

Loadings are not constant



Baltimore Harbor is not well mixed




3B
−5
0
1
2
3
4
5 cm/s
5
10 m

Baltimore Harbor Modeling Challenges

- Extreme spatial variability in endpoints
- Quantification of diffuse sources
- Legacy pollutants in the sediments/soils
- Understanding ecosystem-scale responses to management actions